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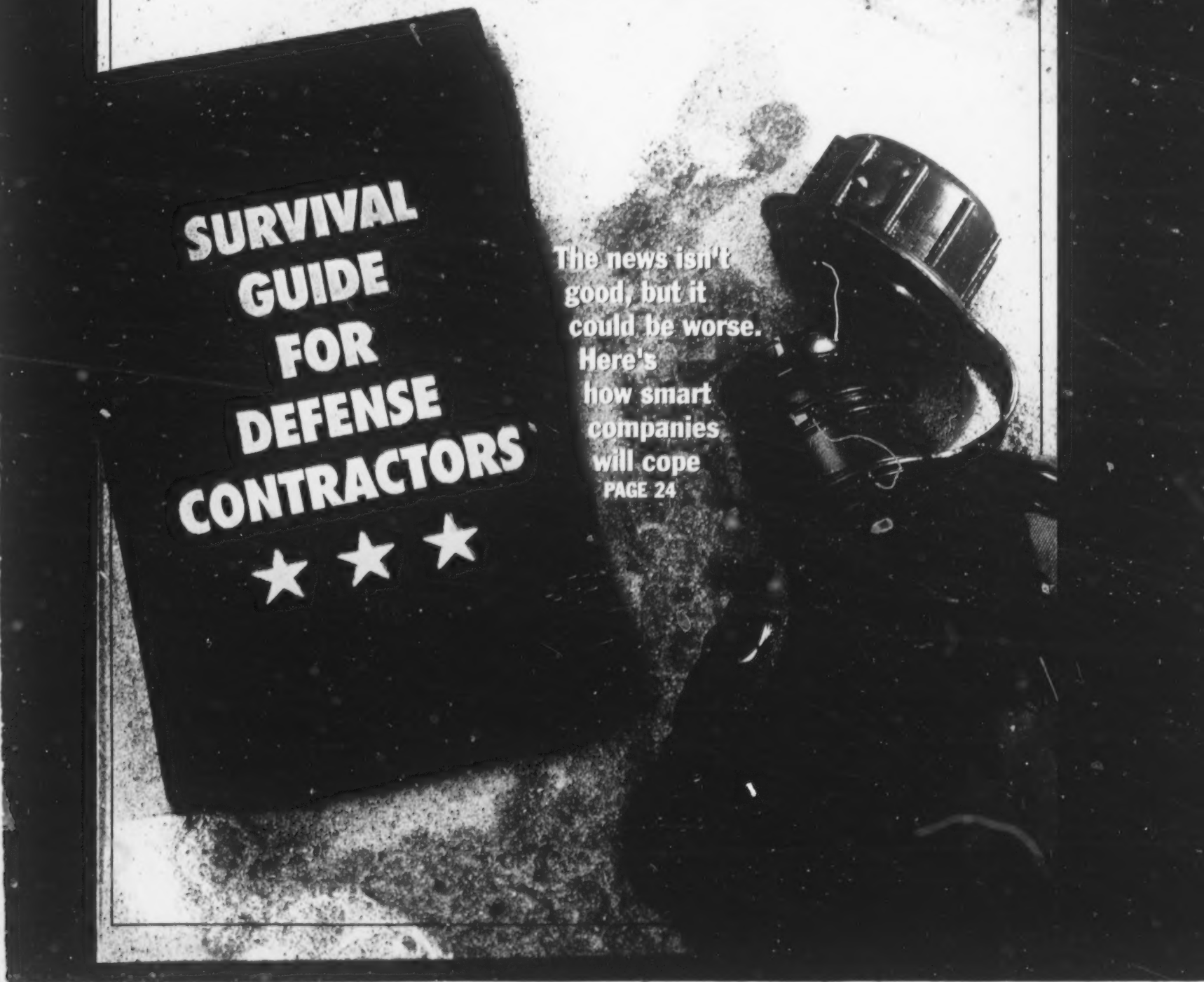
A CAHNERS PUBLICATION

Electronic Business®

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES–WORLDWIDE

JULY 1992



The news isn't good, but it could be worse. Here's how smart companies will cope

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Electronic Business

VOLUME 18, NUMBER 10 | FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES WORLDWIDE | JULY1992

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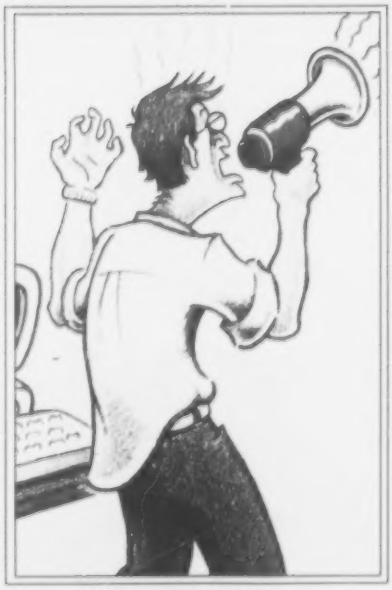

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PRODUCT DEVELOPMENT

Customer complaints are an untapped source for product ideas

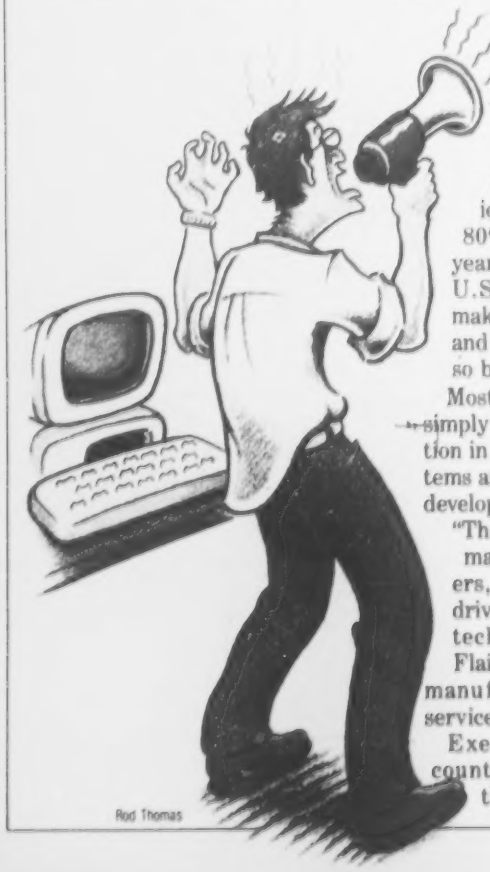
By failing to channel customer complaints into new product development, U.S. computer companies are missing important opportunities to improve their products. What makes this bad news even worse is that German and Japanese execs are far more likely to use criticism as input to product development operations.

These are the key findings of a survey of 116 computer and peripherals companies in the U.S., Canada, Japan, and Germany conducted by the Ernst & Young professional services firm and the American Quality Foundation, a New York-based think tank. The survey examined the companies' quality management techniques that existed three years ago, those practiced today, and what is planned for three years from now.

The results weren't all bad. Forty-five percent of all surveyed executives said that in the past, customers "usually" or "always" played a prominent role in identifying new product opportunities. Today 64% of the surveyed companies involve customers in product development and 77% plan to do so in the future.

Here's a sampling of what customers are learning from complaints: Several midrange computer makers discovered their customers wanted diagnostic capabilities built into the computers for predicting system failures. Other vendors redesigned their computers to more easily accommodate third-party products after scrutinizing customer gripes.

U.S. and Canadian execs, though, are slower than some of their counterparts in mining customer complaints for new product ideas. A majority of German and Japanese computer companies now use customer complaint systems for identifying new products; fully 80% will do so within three years. Only about a quarter of U.S. and Canadian companies make such use of customer gripes, and only 40% to 50% plan to do so by 1995.



Most North American companies simply are not taking the information in their customer complaint systems and using it as input to product development, concludes the report. "That's because unlike and German and Japanese manufacturers, which are more customer-driven, U.S. companies are more technology-driven," says Scott Flaig, national director of E&Y's manufacturing/high technology services.

Executives from all four countries also fail to recognize the value of suppliers in product development. The number that "always or almost always" involve their suppliers is a measly 2% or 3% and little is expected to change in three years. "These companies may be missing an important opportunity to strengthen their supplier relationships and hear a fresh perspective on new product ideas," the report concludes.

Customer visits are also favorite strategies for developing new product ideas, the survey found, and benchmarking the product development operations of "best-in-class" companies will be practiced by more than 50% of the respondents by 1995.

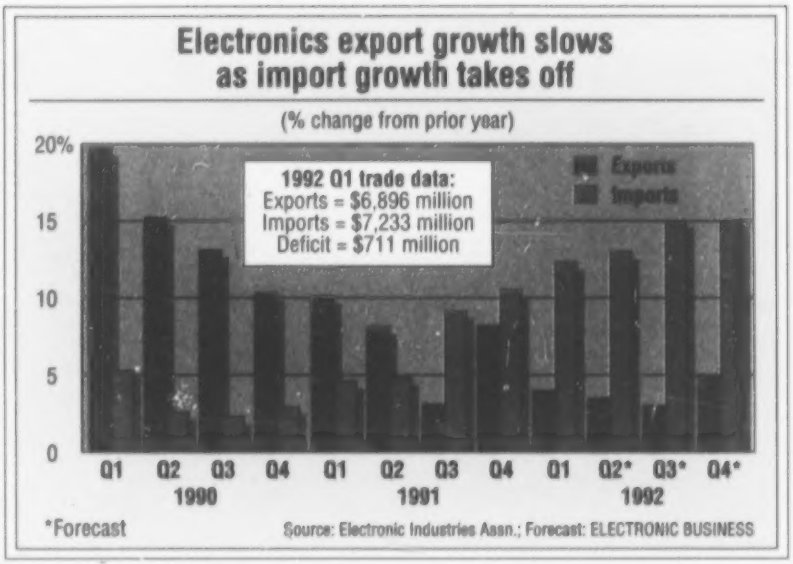
—Rick Whiting

TRADE

Selling abroad gets tougher and trade deficit gets worse

Don't count on '92 exports to make a dent in the U.S. electronics industry's trade deficit with the world. Although the deficit improved in the first quarter from late-1991 levels, it worsened significantly from year-ago levels—and that's likely to continue.

U.S. dependence last year on exports makes this year's projected



slowdown more frightening. In 1991, U.S. factory production of electronic equipment and components grew just 1.7% while exports surged 12.1%. Expect production growth to double this year—still not great—as the U.S. economy revives from its recession. Still, export growth will be cut 6% or less as world economic growth falters.

Recent data from the Electronic Industries Association show the U.S. electronics trade deficit totaled $711 million in the first quarter of 1992. That's down from a $2.8 billion deficit in the previous quarter, but a reversal from a *positive* $701 million trade balance in the first three months of last year. The deficit in early 1992 was caused partly by a surge of electronics imported into the U.S.: imports grew 12.3% in the first quarter of the year, up from 4.6% growth in the first quarter of 1991. In contrast, over the same time period, exports slowed to 4% growth from 10.1% growth the year before.

Global economic growth was weaker than expected in 1991 and likely will remain slow in 1992, dimming prospects for rebounding exports. Economists at the International Monetary Fund (IMF) report world output fell 0.3% in 1991 and will grow only 1.4% in 1992. Japan's growth will slow from 4.5% last year to 2.2%, pressuring Japanese manufacturers to export more to the U.S.

The European economy grew 0.8% last year and will increase 1.8% this year. Leading indicators show a "global business cycle stuck in neutral," says Geoffrey Moore of the Center for International Business Cycle Research at Columbia University.

The end result of the export slowdown may be more protectionism. The trend worldwide: Antidumping investigations rose from 96 in 1990 to 175 in 1991.

—E. B. Baatz

TELECOMMUNICATIONS

Digital to challenge analog in cordless phone market

Despite a variety of problems that include less secure lines and erratic performance, about 9 million analog cordless phones will be sold in the U.S. this year—that's a $707 million market, according to the North American Telecommunications Association. Now, a deal between Teknekron Communications in Berkeley, Calif., and communications equipment maker Taihan Electric Wire Co. in Seoul, promises to bring digital technology to the residential cordless market for the first time.

Digital cordless phones could solve the privacy and performance shortcomings of their analog competitors. Teknekron's technology employs a scheme called code division multiple access (CDMA), which spreads digitized voice transmissions across several frequencies, making them difficult to tap, and gives them extra immunity from noise.

"The biggest challenge is how to bring the cost of the technology down, and our solution to that is to permit the manufacture of large unit quantities," says Edward Chien, executive director of personal communications systems for Teknekron. The phone's price should be competitive with high-end analog phones, which retail for $300 to $400.

Establishing a common design spec is the key to succeeding with digital cordless for home use. There is currently no industry-standard spec. Teknekron is promoting its own Digital Cordless Phone (DCP) systems spec, and has licensed the spec to a number of major analog phone vendors. Chien won't name the vendors, but claims the licensees account for about half of the current market.

Chien says Teknekron's phone can also serve in business environments and within future "personal communications networks" (PCNs). PCN proponents envision a public infrastructure consisting of receiving stations that can accept pay calls from cordless phones that people carry with them at all times.

Teknekron won't be the first to bring CDMA phones to the business and PCN worlds, though. Omnipoint of Colorado Springs currently sells a CDMA-based phone for corporate systems and expects to sell digital cordless phones into maiden PCNs by this fall. Chien argues that the large home cordless market will be the best springboard into the PCN environment.

At least one industry observer, Forward Concepts' president Will Strauss, doesn't discount Teknekron's cordless-to-PCN scenario. "I wasn't expecting any digital cordless phone activity in the residential market for another year, and was really surprised when Teknekron announced its deal with Taihan," he says. "This will get Teknekron a lot of respect."

—Dwight Davis in Seattle

INTERNATIONAL

Japan to rebound quickly as appetite for chips grows

Sluggish times notwithstanding, Japanese pundits expect semiconductor demand in that country will soon rebound and grow faster than in the rest of the world. That's a clear signal to U.S. chip vendors not to ease up efforts to penetrate that market.

Japanese electronics manufacturers remain remarkably optimistic. Components makers such as Alps, TDK, and SMK claim orders are picking up for components to go into exported goods—particularly PCs and consumer goods bound for the U.S. Most major electronics manufacturers claim orders bottomed out in February and are on the way back up for two main reasons: Exports to the recovering U.S. market are on the rise, and companies are finally working off their inventories.

Growth in Japan will average 10.6% through 1995, while the rest of the world will manage only about 9%, according to a new study from the Electronic Industry Association of Japan, with input from 50 Japanese electronics companies and Nomura Research. Even the rest of Asia will average only 9.9%.

Topping Japan's shopping list will be more sophisticated chips to be packed into current products—and the Japanese will likely pack more in faster than anybody. The study figures semiconductors now account for about 10% of the value of industrial electronic equipment in both the U.S. and Japan. But Japanese use will increase faster, reaching 14% by 1995, while the U.S. reaches 13%.

NRI figures the value of MOS memory and logic chips in all kinds of electronic equipment will nearly double by 1995. MOS memory for telecom, for example, should climb from $350 million in 1990 to $650 million in 1995, while MOS logic jumps from $700 million to $1.4 billion. Faxes alone will use $890 million worth of semiconductors by 1995.

The market for video game and other entertainment machines will see only about 20% total growth, but chip content will almost double, from $930 million to $1.8 billion as use of MOS logic increases from $250 million to $540 million, and memory from $540 million to $1.1 billion.

—Paula Doe in Japan

Here's what Japan will buy in 1995

Semiconductor demand by market segment

Semiconductors for:	1995 demand ($ millions)	Annual growth average 1989-1995
Computers & peripherals (other than PCs)	$6,596	14.5%
Personal computers	6,073	13.9
Video (other than TV)	3,578	7.8
Telecommunications	3,448	12.7
Other industrial equipment	2,111	9.3
Video games and education	1,820	14.0
Audio	1,755	3.1
Copiers and other office equipment	1,163	7.0
Total semiconductor demand: $33,350		

Note: Numbers listed do not add up to total because of omission of some minor categories

Y135=$1 Source: EIAJ, NRI

SOFTWARE

U.S. software breaks down Japan's PC market barriers

The next generation of operating system software from IBM, Microsoft, and others should help U.S. companies penetrate a potential $10 billion PC-software market in Japan. Until now, this market has been safely isolated from foreign competition by the twin barriers of the unwieldy Japanese language and proprietary computer architectures, such as NEC's version of DOS. No longer.

A new generation of industry-standard operating systems and user interfaces, led by IBM's OS/2 for Japan, DOS.V, and Microsoft Corp.'s Windows, are designed to easily accommodate the Japanese language and Japanese computer architectures. That means market opportunities for U.S. PC vendors who can sell in Japan the same machines they sell at home and still run Japanese software.

Likewise, U.S. suppliers of application software can adapt their products for the Japanese market with far less effort. And it's not a market to be sneezed at. The Japan Personal Computer Software Association estimates that sales of PC package software in Japan reached about $2 billion last year. International Data Corp. Japan figures although the market for all package software in Japan is only one-third that of the U.S., it's growing about 19% a year and will reach $10.6 billion by 1995.

Indeed, U.S. software companies may be surprised to learn just how successful Japan's trade press expects them to be. The influential *Nikkei Electronics* made much of the big opportunity for U.S. software vendors in a recent cover story detailing the advances in "international" software from Apple, IBM, Microsoft, and Novell. Domestic Japanese software companies, the story concluded, are in for big trouble as U.S.-made software starts to flood the Japanese market.

"Windows and IBM's OS/2 for Japan make porting significantly easier," notes David Pollack of the American Electronic Association Japan's office, who has just finished putting together a book for software companies interested in penetrating the Japanese market. (The book will be available from the AEA in July.) "You still have to do some tweaking with things like screen size, but very little," he says. "Porting work may be cut from, say, a year down to a month."

Making applications handle the complex Japanese language is easier now that system software and user

interfaces can handle the two-byte code needed to deal with Chinese and Japanese characters. Parts of software applications that need to be altered for different countries, such as menus and currencies, are also separated from the core software for easy conversion. Moreover, much of the initial conversion work can be done in English on standard DOS-based computers, thanks to products such as the new Far East developers kit due out from Microsoft.

How much headway are these operating systems making in Japan? With Japanese computer makers providing the OEM channel, some 200,000 copies of Windows had been sold in Japan as of March, and that's expected to reach perhaps 500,000 by the end of this year. Only 10% of all applications sold in Japan by major U.S. software makers were for Windows in 1991, according to the Software Publishers Association, but by year's end, the rate was running 25%. Windows applications are expected to account for 25% to 30% of all U.S. applications sold in Japan in 1992.

—Paula Doe in Japan

DATA STORAGE

DAT market growing—at Exabyte's expense

When 4-millimeter digital audio tape drives arrived three years ago, about 30 companies swarmed into the high-capacity low-end data backup storage market that was first blazed by Exabyte Corp., the lone U.S. supplier of larger 8mm tape drives. Now, after two years of bloodletting and consolidation, the $224 million 4mm market consists of just five significant producers, says Lee Elizer, president of consulting firm Data Storage Concepts.

Despite such consolidation, more 4mm drives were shipped last year than 8mm, according to Elizer—a significant fact, since Exabyte has grown astoundingly fast (to $250 million) on demand for its 2.5- and 5-Gbyte 8mm drives.

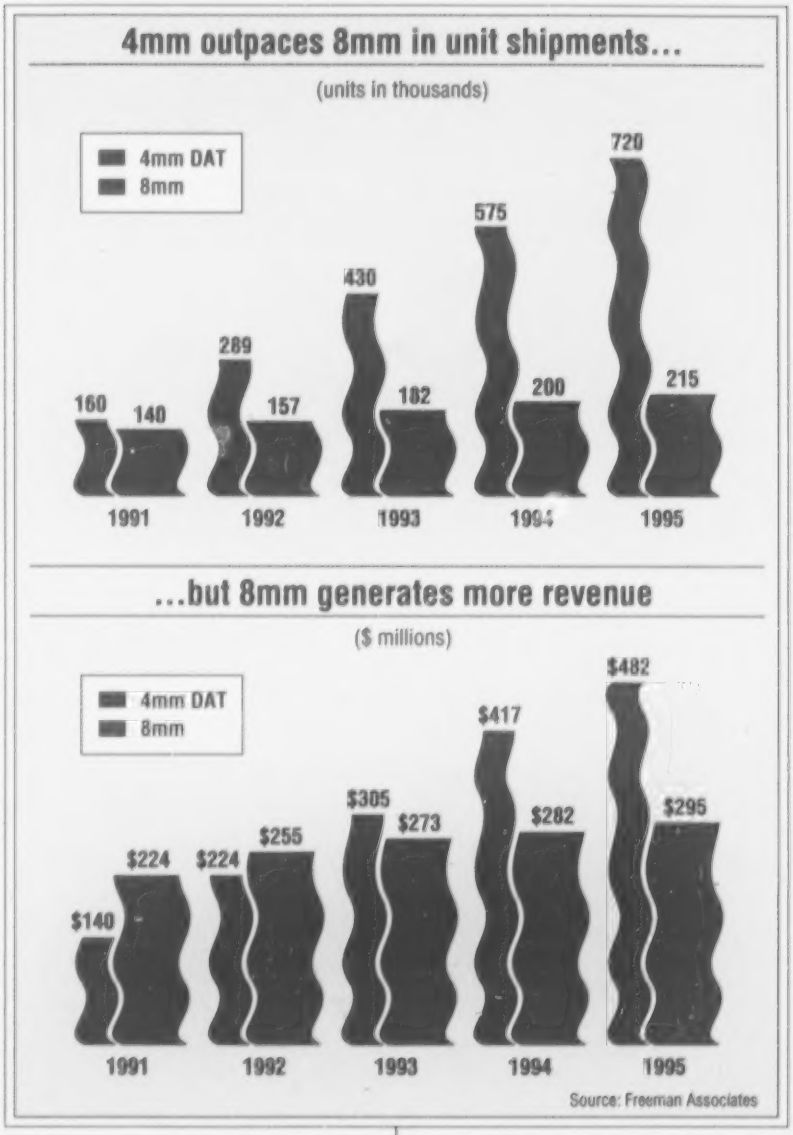
"Exabyte's 2.3-Gbyte drive had a lot more lightning than they thought," says Bob Abraham, Freeman Associates' vice president, explaining why Exabyte exceeded stock analysts' expectations for at least two quarters.

The leading merchant DAT vendors in terms of unit shipments are Archive, Hewlett-Packard, and Rexon (which owns Wangtek and recently acquired competitor WangDAT). Market analysts say HP and Archive are a toss-up for the merchant market share lead at about 35% apiece; Wangtek/WangDAT is a distant third. Trailers include Sony, GigaTrend, R-Byte and Toshiba.

The OEM market competition between 8mm (Exabyte) and 4mm DAT is still hot, however. DAT vendors have relied for the past year upon data compression (both hardware and software) to raise capacities of the base 1.3-gigabyte drive design to 2.5 Gbytes, but Exabyte is starting to cull production of its cash-cow 2.5-Gbyte drives to push sales of higher-margin, higher-performance 5-Gbyte drives.

What DAT loses in performance, it makes up for in size: It is smaller with a 3.5-inch form factor than 8mm, which only comes as small as a half-height 5.25-inch disk drive.

—David Webb in San Jose



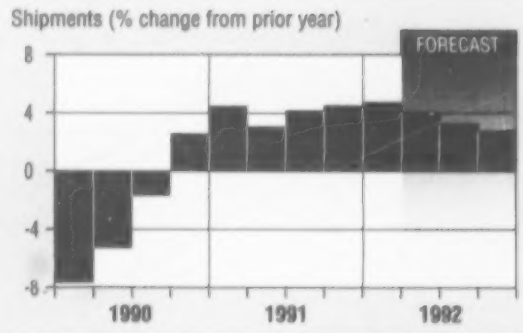
ELECTRONIC COMPONENTS

Component industry recovery begins, despite orders blip

Electronic components makers should expect industry shipments to advance 8.2% to $68.6 billion this year and 11.4% to $76.5 billion in 1993. This recovery is not great by historical standards, but any turnaround is a relief after a couple of sluggish years. Thanks to a pick-up in demand from computer and communications equipment makers, component shipments—everything from chips to wire—climbed 4.3% above year-ago levels in the final quarter of 1991, and the trend continued through the first quarter of 1992 as shipments advanced 5.3% to $16.1 billion. Two consecutive quarters of solid growth have been a long time coming; the last time the industry reported similar growth was during late-1989.

The industry isn't free from worries yet, however. New orders for electronic components fell 8.2%, 3.8%, and 10.5% from year ago levels in February, March, and April 1992, respectively. But with end-markets for components—particularly computers, communication equipment, and instruments—reporting growing orders, the drop in component orders is expected to be temporary. Another indicator that bodes well for component makers is buyers' reports on delivery times. According to a monthly survey of 500 buyers by our sister publication *Electronics Purchasing* magazine, lead times have finally begun to stretch. Delivery times for electronic components have risen about 2% during the 12 months ending June 1992, up from the 5%-plus declines of a year earlier.

—Julie Handelman-Sagan



($ billions)					FORECAST			
Orders	6.87	6.62	7.24	6.88	7.02	7.15	7.45	7.19
Shipments	6.97	6.90	7.17	7.16	7.18	7.19	7.49	7.50
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
	1991				1992			1993

Source: Commerce Dept.; Forecast: Cahners Economics

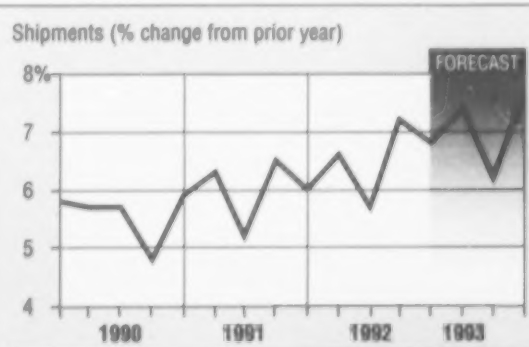
INSTRUMENTS & ATE

Higher productivity needs drive measure & control sales

The measuring and controlling (M&C) instruments market will grow a modest 4.1% to $29 billion this year followed by 3.7% growth to $30.1 billion in 1993. Historical data suggests that demand for M&C instruments should not have begun rising until after the nation's factories pick up steam and begin expanding in late-1992 and 1993. Although industrial output increased through the first five months of this year, factory capacity utilization rates remained low. Businesses, however, struggled to cut costs and improve productivity during last year's recession. As a result, demand for M&C equipment has been benefiting earlier than usual during the 1992 upturn. Orders, for example, surged a strong 13.6% in April from a year ago, offsetting two declines in February and March.

Of course the variety of M&C instruments responsible for a 4.5% year-over-year rise in shipments during the first quarter of 1992 are the lower-priced equipment used in control processes. The higher-cost, higher-tech test equipment continues to suffer from tight capital budget restraints in 1992. The ELECTRONIC BUSINESS automatic test equipment (ATE) sales index fell 5.9% below year-ago levels during the fourth quarter of 1991 and slipped 0.3% during the first quarter of 1992. ATE sales are expected to fall 2.5% in 1992, but higher production and quality demands in 1993 will loosen the reins on capital spending so that the ATE index will rebound 8.8%.

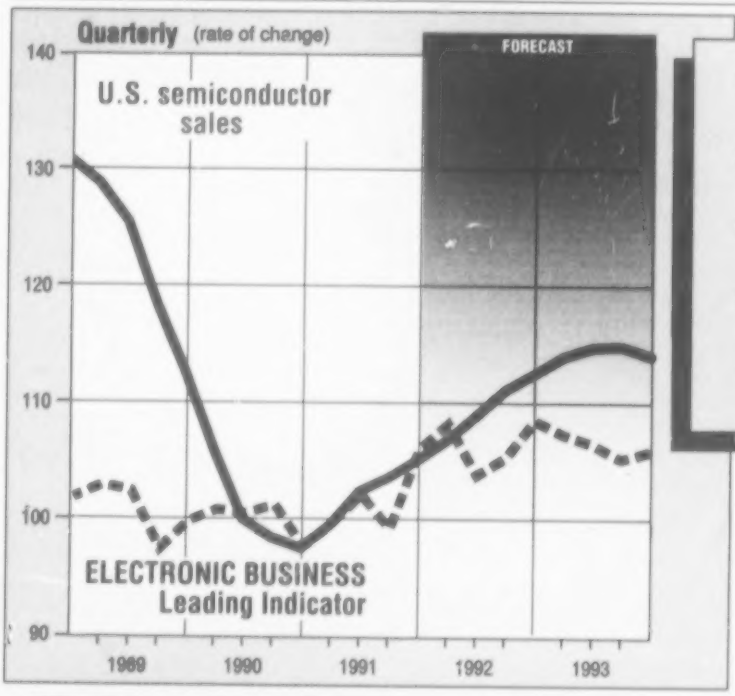
—John Farrell

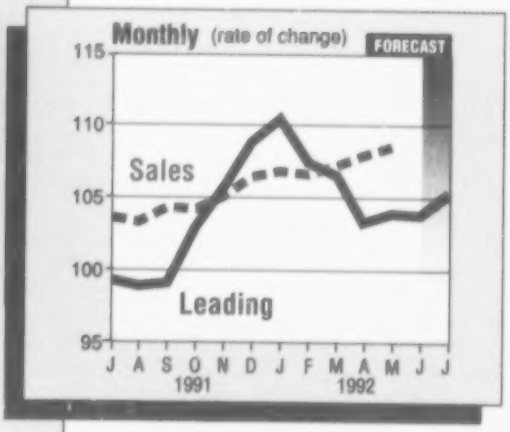


($ billions)					FORECAST			
Orders	15.6	15.7	16.9	15.8	16.7	17.3	19.0	18.0
Shipments	15.9	15.9	16.3	16.1	17.1	17.4	18.1	18.0
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
	1991			1992				1993

Source: Commerce Dept. & *Electronics Purchasing*; Forecast: Cahners Economics

ELECTRONIC BUSINESS Leading Indicator



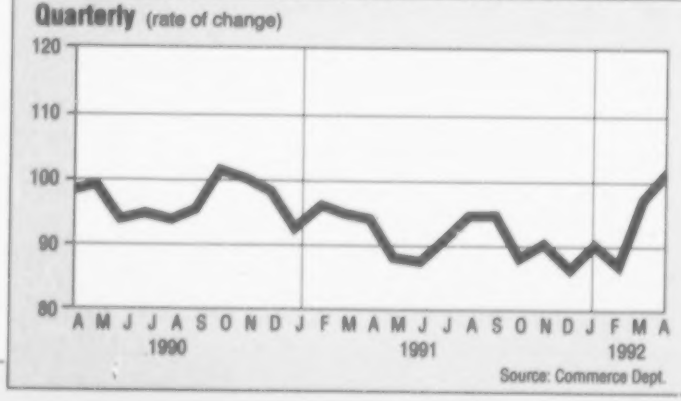


Indicator back on track this past May

The ELECTRONIC BUSINESS Leading Indicator (EBLI) rose from a revised 103.3 in April to 103.9 in May. That positive step, no matter how slight, is a welcome sign after last year's downturn (which began with a drop from 103 in April to 101 in May.) Signaling a recovery in progress, EBLI has now recorded eight consecutive months above 100. In fact, EBLI has remained above 103, the longest such streak since 1988. The current EBLI upturn began last October and has already been followed by a rebound in the chip market.

—John Farrell

Plant & equipment orders break growth barrier

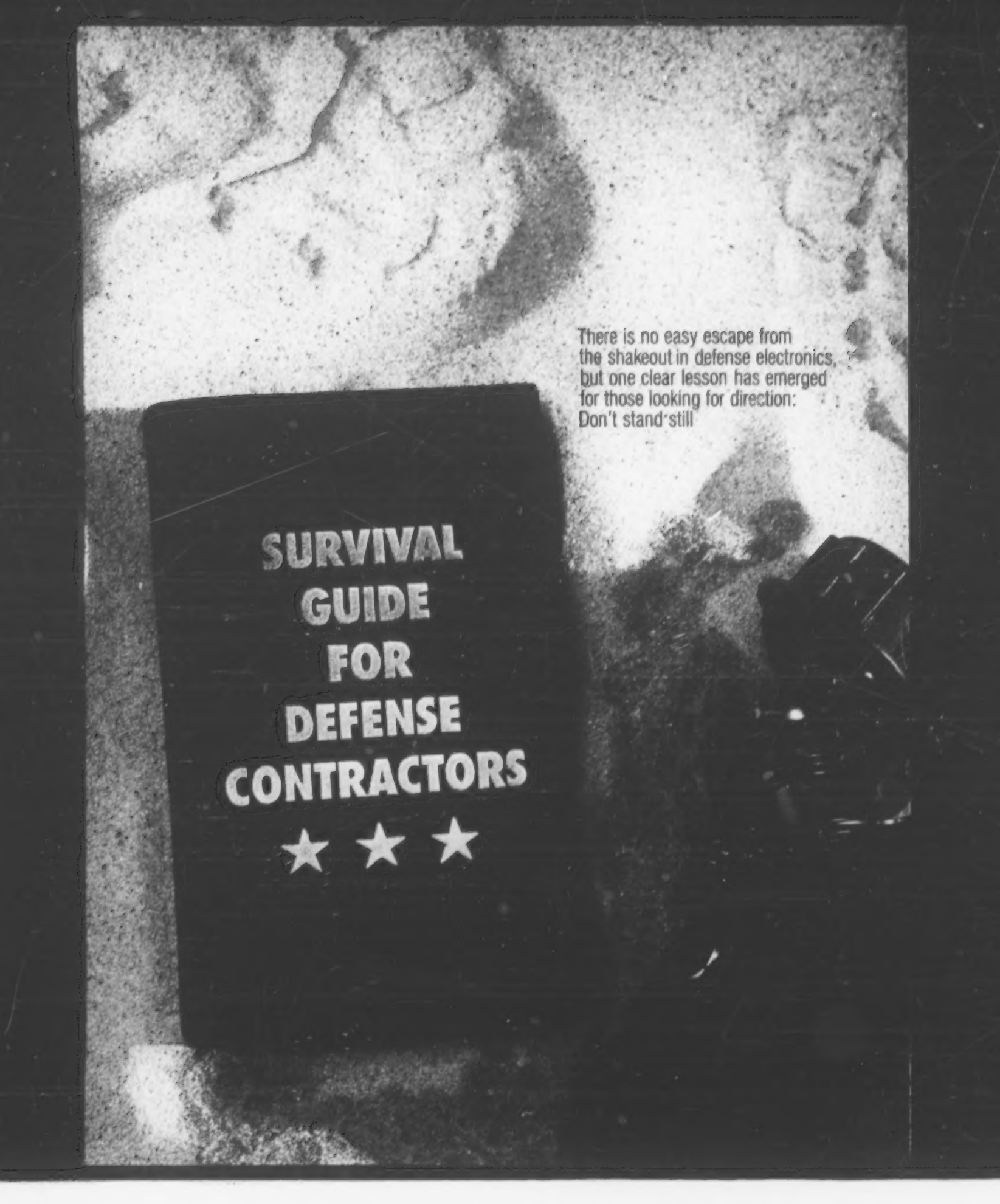


Source: Commerce Dept.

	Latest month	Previous month	Year ago	1991 average
ELECTRONIC BUSINESS Leading Indicator (rate of change, May)	103.9	103.3	101.1	101.6
U.S. semiconductor bookings ($ millions, 3-month average, May)	$1,608	$1,605	$1,368	$1,311
Weekly hours of semiconductor production workers (monthly average, Apr.)	42.8	42.8	40.8	41.1
Electronic components lead time index (1977 = 100, Jun.)	68.4	83.7	94.2	87.5
S&P's semiconductor stock price index (1970 =10, monthly average, May)	81.4	82.1	73.2	68.5
Change in electronic components inventories ($ millions, SA, Apr.)	-$44	-$34	$91	-$53
Contracts and orders for plant and equipment ($ billions, SA, Apr.)	$36.7	$37.7	$34.1	$35.0

SA = seasonally adjusted; all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, Commerce Dept., Bureau of Economic Analysis, Cahners Economics



There is no easy escape from the shakeout in defense electronics, but one clear lesson has emerged for those looking for direction: Don't stand still

SURVIVAL GUIDE: CHAPTER ONE

By Peter Burrows

It is literally do-or-die time for thousands of the subcontractors and captive electronics suppliers that serve the U.S. Department of Defense. Blindsided from their cozy existence under the Pentagon's wing by the crumbling of the Soviet Bloc, many have already gone bankrupt, been acquired, or simply closed their doors. Others, with multiyear contracts coming to an end and few new projects in the hopper, are frantically searching for new strategies to help them survive—at least until the new shape of the U.S. military-industrial complex emerges.

It is difficult to quantify the damage, as the government leaves the tracking of these lower tiers of the defense market to its prime contractors. The U.S. Congress's Office of Technology Assessment does estimate that small companies received about $47 billion in DOD contracts and subcontracts annually from 1986 to 1990, but there are indications that this level of funding is falling even faster than the defense budget (see box).

The bottom line? As bad as it is for the prime contractors, life is even tougher for some of the little guys.

Consider, for example, the plight of Lau Technologies, a $25 million military contract manufacturer in Acton, Mass. It gets about 50% of its sales assembling boards for the Bradley M1 fighting vehicle, which will be discontinued in 1994, and the Abrams M1A2 tank, of which the government has decided to buy just 63, down from the 8,000 order around which Lau structured its bid.

Although Lau's productivity is above average and its customers seem satisfied—it received an U.S. Army Contractor Excellence Award in September 1991 for service rendered during the Gulf War—the company expects to lay off half its 190 workers if no unexpected procurements come through by year's end. As for the future, its executives have few answers. "We just have to hope the DOD continues to need the kind of capabilities we supply," says James Bender, vice president of the company's land systems division. "If they do, we'll survive. If they don't, we won't."

Clearly, however, this is no time for stoicism. Although most captive defense suppliers lack the marketing expertise and cost efficiency to compete outside their home market, they are nonetheless heading off in a variety of directions. Favorite destinations include the defense agencies of foreign governments, non-DOD U.S. government agencies such as NASA and the Department of Energy, and commercial markets.

Such transitions would be hard enough in the best of times. Unfortunately, an almost epic set of roadblocks—including the worldwide recession—has emerged that threaten to snarl such survival plans at almost every turn:

- Don't count on foreign defense sales. While nations such as Saudi Arabia, Korea, and Japan are buying military goods to compensate for reduced superpower spending, federal COCOM export control regulations prohibit or complicate sale of many systems and components, giving the advantage to aggressive European exporters;
- Don't expect an easier time selling to DOD or other federal agencies after the shake-out. The U.S. military may still be the world's biggest electronics customer, but the dearth of new platform starts has led many prime contractors to compete for the lower-volume contracts that have been the life-blood for lower-tier suppliers. "We now see 30 bidders where we once saw three or four, and the newcomers include companies like Boeing and Rockwell," says Jim Smith, president of AIL Systems Inc., a subsidiary of Eaton Corp. in Deer Park, N.Y. The result, predictably, is a tougher fight for every contract. AEL Industries Inc., an

avionics and electronics subsystems maker in Lansdale, Pa., reports that its win ratio is down from about 70% five years ago to about 35% today, and president Mark Ronald expects it to go down even more. The consolidation of military programs, such as the Air Force's merging of its Strategic Air Command with its Tactical Air Command, heightens the problem by reducing the number of overall DOD customers;

Dave Bradley

"Conversion is a myth," says Lau Technologies' president Joanna Lau. "What commercial markets can we walk into with this recession going on?"

- Don't assume continued business from your existing customers in the contractor community. In an effort to avoid further layoffs and utilize empty capacity, many prime contractors are sub-contracting less and working to become more vertically integrated. Raytheon Corp. in Lexington, Mass., for example, has reportedly pulled much manufacturing in-house to meet union commitments regarding downsizing;
- Don't bank on moving into commercial markets. While this is the strategy currently in favor with the policy gurus, executives say this is the most unlikely survival path of all. Having served just one end-customer—the DOD—for all their lives, captive suppliers typically lack the marketing and distribution expertise to break into already cutthroat commercial markets.

"A book about successful diversification in the defense industry would be the shortest book ever written," notes Jack Modzelewski, vice president of aerospace and defense for PaineWebber in Manhattan. The lesson, he says, is clear: "Diversify at your own risk!"

So what is the small defense electronics company to do? First of all, avoid shellshock and take a frank reckoning of your strengths and capabilities. Here are some of the key factors to consider when charting your course:

- Who are your key customers? With the prime contractors in as much disarray as their suppliers, their new strategies may be the most critical factor in your long-term plans;
- How big is your company? Small companies in large markets that have superior technology and broad service can probably survive as non-diversified DOD suppliers—assuming no prime contractors have decided to steal their markets at any cost. "We're waiting to see how rapidly the defense environment collapses," says AEL president Ronald. "We just want it to get to steady state, because at our size we know we can find a place for ourselves. After all, the U.S. defense market is still the biggest in the world;"
- Check your backlog. Companies that have years left on key programs may take more time and invest more prudently to develop long-term diversification plans. If the well is dry or almost dry, it may be time to downsize, take on debt or issue stock to raise restructuring capital, or find a partner. "The DOD may find dollars for your project, but you can't afford to wait to find out,' says Steve McCann, manager of business development for Codar Technology Inc., a ruggedized workstation vendor in Longmont, Colo. "You have to cut to the chase."

The result of all this strategizing is mass confusion. Some companies are racing to commercial markets; others steer clear. "When we see a commercial market, we run," says Ron Hehr, manager of tactical marketing for United Technologies Microelectronics Center, a UT sub-

Sizing up the coming shakeout

	Decrease in contract obligations, 1985-1990	Decrease in prime contracts awarded, 1985-1990
Aircraft industry	52%	17%
Communications equipment	33	16
Electronic components	40	16
Guided missiles	35	35
Tanks	56	37

The number of DOD contracts awarded is down, but not nearly as much as overall defense spending. That means overcapacity and probably reduced subcontracting, neither of which is good for the defense electronics supplier base. "One thing is clear," says Defense Budget Project analyst Conrad Schmidt. "Someone other than the primes have been absorbing the blow."

Source: Defense Budget Project

Tracking one cutback down the defense supply chain

WHEN RUMBLINGS BEGAN in 1989 about possible reductions in the procurement of the Abrams M1A2 tank, prime contractor General Dynamics Corp. surveyed 140 of its project subcontractors to learn how they would respond should the bad news come to pass. Of those polled, 15% said they would go out of business and another 15% said they would be forced to close a facility.

Unfortunately, the worst fears seem likely to come true. Not only has the Pentagon reduced its procurement plan from 8,000 to just 63, but GD's campaign to have DOD upgrade about 3,300 of the earlier generation M1A1s has bogged down. Concerned by the withering industrial base for the program caused by these cutbacks, the Saudi Arabian government is reportedly reconsidering a $10 billion 465-tank order.

Unfortunately, the bloodshed among GD's 9,000 suppliers seems to be right on schedule. Tom Bledsoe, VP of materiel for GD's land systems division, points to a smattering of Chapter 11 filings. Far more common, as the chart shows, is painful downsizing throughout the supply chain. □

M1-A2 tank cutback does industry damage

Here is some expected fall-out if the government reduces procurement from 8,000 to 63 as planned

The prime contractor. The land systems division of $8 billion General Dynamics will not dole out the $3 to $5 billion in contracts it had planned to award over the next 8-10 years.

The sub-contractor. $150 million-plus Smith Industries, which builds the MI-A2's position navigation system, will lay off 10% of its work force and eat 50% of its R&D costs on the tank program.

The services company. $25 million contract manufacturer Lau Technologies will not build the mil-spec circuit boards that bring in almost half of its sales, and will layoff half of its 200 employees.

The components supplier. $10 million hybrid IC maker White Technology will lose half of its sales as well, and will layoff 25% of its 120 employees.

sidiary in Colorado Springs that makes radiation-hardened ICs.

One company running in the opposite direction is White Technologies, a specialty memory and hybrid IC maker in Phoenix. Soon after the decision to reduce procurement of the M1A2 tank was announced, White's management sought out commercial markets for the chips developed for the tank program. "Five of our customers were involved with that tank, so it really affects us," says Dan Tarantine, senior vice president of sales and marketing for the $10 million company.

Going commercial won't be easy. Tarantine even has doubts White will fully recoup the $1 million it invested in the tank program, as high overhead costs related to its continuing military business make it very difficult to compete in the more price-sensitive commercial market. For example, the company must maintain a three person staff to ensure compliance with DOD specifications and must comply with a time-consuming equipment calibration regimen. Ironically, these costs have forced White to bypass its own fab and outsource manufacture of the commercial chips to a contract house in the Philippines.

If there's a lesson in White's predicament, it is that knee-jerk reactions rarely work; well-developed diversification strategies are required. One company that has done this is ThermoTrex Corp., a subsidiary of Thermo Electron Corp. in Waltham, Mass. "Our objective has always been to use the funding that defense contracts afford you to come up with commercial applications," says president Firooz Rufeh.

In the past, the company has used this philosophy to convert a technology to measure minute quantities of gases into a product to measure carcinogen levels in foods and has converted an explosives-detection system into a drug-detection system. When DOD cutbacks drained this reliable capital pool, the company went public last year to fund development of three more follow-ons to military products, including a radiation-free medical imaging product and a microwave camera to help commercial pilots see through fog.

ThermoTrex plans to increase its proportion of commercial sales from about 20% today to about 50% in the next few years and ultimately to about 80%. The company has much in common with the coterie of DOD suppliers who have successfully made the jump to the commercial world. For one, it has set up separate operations for its commercial efforts. It has also set realistic time horizons; like many executives, Rufeh gives commercial ventures 12 to 18 months to show signs of life.

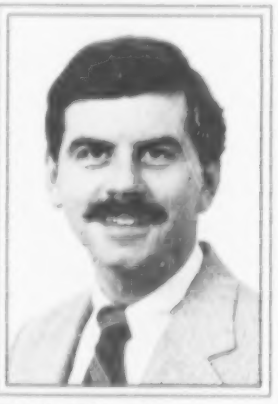
"Unless the defense supplier has successfully set up an entirely separate commercial entity and brought in commercial managers, then I don't see much chance for success," says Dataquest analyst Greg Sheppard.

"You have to break people out of their old organizations," agrees AIL's Smith. "Otherwise they're too comfortable." Having clearly stated his intention to develop at least one successful non-DOD business, Smith set off 10 company veterans, gave them direct access to his office, and a promise of necessary funds.

Given defense electronics companies' traditional lack of marketing experience, many have hooked up with strategic partners to get their commercial campaigns going. In addition to its defense business, Aeronvironment Inc., a well-diversified R&D house in Monrovia, Calif., has long worked with GM to develop solar- and electric-powered vehicles for the commercial market. Group Technologies Corp., a contract manufacturer that was spun off when Honeywell Corp. began divesting many of its defense businesses in the mid-1980s, has used its expertise to jointly develop products with AT&T and Lockheed Corp. The AT&T product, which promises to bring conference calling to secure communications, will be announced later this year.

Of course, a company's current product line will determine the success of any conversion strategy. Those who can easily spin off core DOD-related competencies to other markets are best off. Group Technologies, for example, used the secure communications technologies it inherited from Honeywell as a building block for a $30 million market in electronic key management systems—a market that developed after the Walker spy ring exposed the security risks associated with paper-based security codes. Lau, while actively avoiding commodity markets, plans to bring its manufacturing expertise to the medical electronics market. "In both medical and military markets, we're talking about life and death," says president Joanna Lau. "Customers in both need the quality and reliability we offer."

SOME TRULY RADICAL diversifications are in the works. Aeronvironment has pursued an eclectic array of markets for its 6-foot-long, 8-pound unmanned flying vehicles. Used during the Gulf War for surveillance and reconnaissance, they are under evaluation by the Los Angeles Police Department and have been looked at by whale watchers, forest-fire spotters, and even papparazzi in search of a birds-eye view of Elizabeth Taylor's wedding. AM General, a division of LTV Missiles and Electronics Group, is selling civilian versions of its jeep-like Humvee (high-mobility multipurpose wheeled vehicle) for around $40,000. Its new customer base includes Arnold Schwarzenegger.



"It's hard to make our supplier base secure," says General Dynamics VP Tom Bledsoe. "We can only keep them informed"

The most fortunate DOD suppliers of all are those that find their best opportunities in their existing markets. AEL, for example, has maintained its revenues through the downturn on the shoulders of some prudent decision-making in the late 1980s, when the company invested heavily to get entrenched in electronics-laden tactical programs that have for the most part escaped the cutbacks. "We have been reasonably successful in guessing," says Ronald, the company's president. "We didn't go in for SDI, the B-2 bomber, or any antiballistic missile programs—although some of that was just plain luck."

More recently, AEL has focused on its aircraft retrofit business. For one, this business is at the heart of DOD's strategy to remain preeminent through upgrades rather than with new weapon platforms. Also, an airport facility is required to get into the business—an imposing entry barrier to would-be competitors, notes Ronald. He adds that budgetary pressures on DOD program managers has forced them to look beyond the primes who monopolized the upgrade business just 10 years ago. "We're even getting sole source business now; for the first time, the Pentagon has taken to calling us direct."

Others are in less enviable positions. Many makers of ruggedized computers, such as C3 Inc. and KMS Advanced Products, have flirted with Chapter 11 or been acquired as a result of rising competition from a host of prime contractors in search of high-volume computer contracts. C3, a $106 million company based in Herndon, Va., recently lost a Navy contract that had supplied 70% of its revenues to $11 billion Hughes, despite being the incumbent. "Hughes would have never looked at that contract before, but they cleaned our clock," says Bob Moreno, executive vice president of sales and marketing. "We couldn't have taken the contract at the price they got."

That experience reinforces the perception that even companies not prepared or not interested in going commercial must make big changes to survive as captive DOD suppliers. For one, such companies must buddy up ever closer with their customers, no matter how difficult those customers make the experience.

"When the Berlin Wall came down, many of the primes we do business with stopped making multiyear procurements and went to single-year buys," says White Technology's Tarantine. "When the Soviet Union fell, many went to a quarterly schedule."

Despite similarly shortened schedules, Joanna Lau continues to make bulk purchases of supplies in an effort to keep costs down at the contract manufacturing house she runs. "It's a big risk, since I won't be reimbursed" if follow-on orders don't come in, "but you have to act without a safety net now," she says. "You either come out OK or you're a loser. But, hey, this is scramble time."

Lau also continues to bid contracts at less than the expected cost—standard operating procedure in the heady days of the Cold War. This risk-it-all approach may work for some, but most observers insist that conservatism is required now. "Anyone with any sense will charge everything at cost," says UTMC's Hehr, even if it does give heartburn to program managers used to low-ball bids.

Increased openness regarding R&D plans and financial health can help counteract such disappointment. But don't expect a revolution in customer relations. With their own pains at an all-time high, prime contractors and program managers are not likely to go far out of their way to assist their suppliers.

General Dynamics, for example, figures it must downsize from 105,000 employees in 1987 to just 63,000 by 1995, and plans to reduce capital spending from $1 billion in 1990 to $575 billion in 1993. "It's hard make our suppliers secure, since we can't tell them anything more than we know," says Tom Bledsoe, vice president of materiel for GD's land systems division in Sterling Heights, Mich. "All we can do is keep them informed." To its credit, GD has involved key suppliers in an all-out public relations blitz on Washington to save the M1A2 program, and has put together an impressive communications program to keep suppliers as up to date as possible.

The government has been no more helpful than the primes, say suppliers. Despite good intentions at the policy level, program managers continue to succumb to low-ball bidders and to drive down profits by seeking dual sources even for small contracts. Despite talk of waiving certain DOD regulations on commercial companies subcontracted by defense suppliers—so long as the supplier accepts responsibility for the quality and reliability of resulting products and services—few program managers have given up this level of control. The added regulation sends most would-be commercial vendors running, driving up program costs.

Despite the seeming confusion, there are some common threads through the maze of emerging strategies. First and foremost is the need for world-class quality and productivity. This trend began even before the worst cutbacks occurred; General Dynamics, for example, has slashed its supplier list from 1,200 in 1988 to about 600 today through a total quality management drive.

An almost eerie set of roadblocks, including the recession, threaten to snarl survival plans at almost every turn

Paramax Systems Corp., the recently renamed defense division of Unisys Corp., provides a good example of what needs to be done. By increasing its training budget by about 300% and increasing spending on automation by 10% annually—despite four years of flat revenues—it is improving productivity by 10% a year, says vice president W. Lee Shevel. The results include a $400 million-plus contract to develop ground-based software for NASA's space shuttle program and a $39 million order for air traffic control systems for the Federal Aviation Authority.

Unfortunately, most of this year's productivity gains will be the result of downsizing—possibly to the tune of 1.5 million jobs lost nationwide by the time it's all over, according to the OTA. As always, the secret is to cut as aggressively as possible without threatening the survivability or core competencies of the company. AIL's Smith, for example, oversaw the reduction of the company from a 5,300-person, $960 million entity in 1988 to a 1,700-person, $250 million company today. Although painful, the company has not lost money through the transition.

One area that should not be trimmed, however, is marketing. "Many of the guys running small defense companies set up shop 20 or 30 years ago with a good idea and one or two customers," says analyst Barry Blechman, president of Defense Forecasts Inc. in Washington, D.C. "Now they are having to learn how to market their products." □

SURVIVAL GUIDE: CHAPTER FOUR

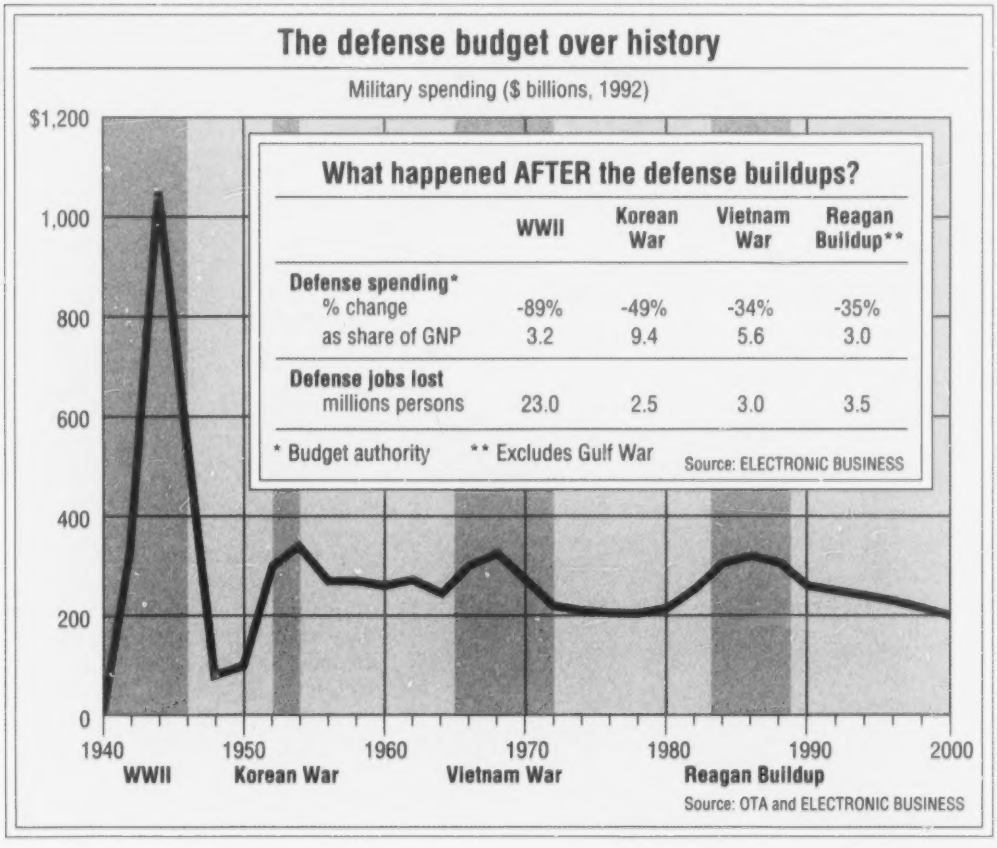
Why the DOD budget isn't all gloom and doom

Yes, it's falling like a rock, but smart companies still have a few new opportunities to get a piece of a $38 billion pie

E. B. Baatz

Digging into the Defense Department budget isn't a task for the faint-hearted: The funds are plummeting, and the budget process is in chaos. Behind the negative facade, however, some signs of opportunity flash, especially for electronics manufacturers.

Interpretations of the budget vary. Take the contrasting statements made at last April's Electronic Industries Association (EIA) budget conference. McDonnell Douglas's Robert Brownlee, chairman of the EIA's de-



fense forecast subcommittee, predicted that "the defense budget will remain a large and attractive market—$200 billion in real 1992 dollars by the end of the decade. There will be a healthy industrial environment for those that survive." Later that day, however, consultant Charles M. Herzfeld, former director of the Department of Defense Research and Engineering, warned that "budgets will go down faster than we are planning for. That implies a large force reduction and a large procurement reduction."

The problem for the defense-electronics industry, of course, is that they're both right.

If there is a strategy in the defense cuts—and experts disagree on that, too—it's that the emphasis of future weapons acquisitions will be on equipping a smaller, quicker, more mobile force to fight regional conflicts now that the Soviet nuclear threat has vanished. That means more opportunities for electronics makers. So while the total defense procurement and RDT&E (research, development, test, and evaluation) spending will fall about 3% annually from now to 2000, Barry Blechman, president of International Defense Technology Inc. in Washington, D.C., predicts defense electronics will grow 2% annually. Appropriations for defense electronics will bottom out in fiscal 1993 at $38 billion in constant 1992 dollars, down from a peak of more than $60 billion in 1985, and will gradually increase to $47 billion in real dollars by the end of the decade.

Although Blechman is somewhat more bullish about prospects for defense electronics than the EIA or others, most analysts agree that space systems, surveillance, communications, simulation, and related electronic-based functions will receive priority funding in the emerging military. The winners will include

Defense cuts hurt some regions more

CONGRESS'S BIGGEST concern about the defense cuts being considered now isn't the strength of the U.S. military. It's jobs. In 1987, at the height of the Reagan-era defense buildup, 6.7 million people were employed in defense industries or in the military. Estimates of total defense-related job losses in the next five years range from 906,000 jobs (assuming the Bush's fiscal 1993 budget holds) to more than 1.5 million under the worst-case scenario, in which defense spending drops to $169 billion by the year 2001. Some of these jobs will be lost due to attrition. In nine years, defense-related employment could go as low as 3.6 million, a 46% drop from the 1987 peak, says the Congressional Office of Technology Assessment (OTA).

Most experts expect the impact of these job losses on an economy that employed 119 million people in 1991 to be relatively minor, especially compared with the cuts after the Vietnam War. Yet several factors—such as the lack of a government plan to take defense contractors back into the civilian market, relatively weak economic growth expected over the next decade, and burdensome debts—may make the transition for ex-defense workers tough.

Over half of all defense spending in the U.S. took place in eight states (see table.) The pain of the defense cuts will indeed be severe for some communities. "When GE Aerospace employment drops from 7,800 to 2,900 in a town like Pittsfield, Mass., with its population of 50,000, the community effects are just as devastating as if a whole defense company had gone out of business," say OTA policy strategists.

Finally, because defense industries employ a greater-than-average number of engineers, these professionals will face a special challenge. About 342,000 defense engineers were employed in 1990; up to 127,000 of those jobs may be gone by 1995. □

Ten states hardest hit by defense cuts

Defense industry employment, fiscal years

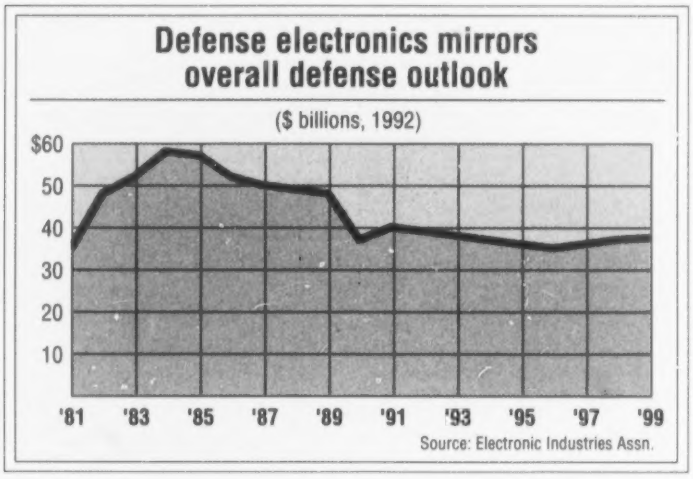
	Defense in 1991		1991-1997
	Number employed	Share of all employment	Number of jobs lost*
California	569,523	4.1%	149,931
Texas	202,676	2.5	62,264
New York	185,532	2.4	59,291
Virginia	155,270	4.9	48,340
Massachusetts	140,352	4.8	41,646
Ohio	132,442	2.6	41,537
Pennsylvania	123,108	2.2	38,140
Florida	119,406	2.0	35,693
Connecticut	99,419	6.0	35,065
New Jersey	93,841	2.5	28,719

*Employment effects under Bush fiscal year 1993 DOD budget

Source: Defense Budget Project

new command, control, and communications systems; upgrades of avionics and electronic warfare systems; development of new tactical missile systems and "brilliant" munitions; a proliferation of space-based assets and their integration with tactical forces; advanced computers and data communications systems; and advanced inter-netted simulation systems that will allow several battalions to simulate entire battles together.

The question for corporate planners boils down to pinpointing exactly which programs will thrive and which ones will die. Finding those answers isn't easy; decisions about individual programs tend to follow parochial lines, and there's little political consensus about specific programs. "[The debate] is no longer between hawks and doves," says Byron Callan, defense analyst for Prudential Securities in New York. "It's between those [Congressmen] who want jobs and those who don't have jobs in their districts."



All this leads some to doubt the efficacy of forecasting which weapons programs will win and which will lose. "I don't think [the government] has a strategy. They are playing a big politicized game," says Robert Costello, former undersecretary of Defense. If there's any rationale to the cuts, he conjectures, it's that "projects with a proven, successful track record will be continued. If a program is questionable, then it is sure death now. Congress has a lot of money to spend, and they'll spend it where they won't get criticized."

WHILE WEAPONS procurement and operations and maintenance accounts in the defense budget draw much criticism in Congress, R&D appears to be a safer bet.

"The only consensus among the mainstream is to protect R&D accounts," says defense analyst Tom Baranauskas of Forecast International/DMS in Newtown, Conn. In fact, the weapons procurement account took a 7% hit from fiscal 1992 to the proposed 1993 budget. Government authorizations for all RDT&E rose 5.1% to $38.8 billion, which is 1.5% real growth, after inflation. That paints a rosy scenario for R&D, right?

Not necessarily. For example, the following paragraph from an analysis of the 1993 budget from the Defense Budget Project in Washington, D.C., implies the government's commitment to R&D isn't as strong as a cursory glance at the budget might suggest. "While the proposed fiscal 1993 budget includes a 1.5% increase in R&D funding from the *proposed* 1992 DOD budget, the proposed 1993 R&D budget represents a 1% real decline compared with the *enacted* 1992 budget, and a 5% real decline compared with the 1993 budget estimate included in the February 1991 DOD spending plan." In other words, the administration's commitment to defense R&D is far from optimistic.

Besides all this, R&D simply isn't as lucrative a business for defense contractors as the cost-plus, profit-loaded weapons contracts. "The R&D dollars you see in the budget don't translate into hardware. It's a lot of paper pushing," says analyst Greg Sheppard of Dataquest in San Jose.

The other major change in the defense budget is not of how much money or what types of programs to fund but how to spend the money. The fiscal 1993 DOD budget unveiled an entirely new acquisition strategy. Instead of starting production of new weapons systems before the R&D phase is completed, production now will wait until after R&D has been finalized.

The new strategy aims to minimize risks, says analyst Steve Kosiak of the Defense Budget Project. This approach will be complemented by increased funding to modify and upgrade current weapons systems so that they will last longer. To the extent that weapons upgrading means more sophisticated electronics, this trend represents an opportunity for some defense electronics manufacturers.

"Cutting back on 21st-century weapons and the new emphasis on upgrades and add-ons means a growing slice of the defense pie will

How one Wall Street expert sees the shakeout

JACK MODZELEWSKI, vice president for aerospace and defense at PaineWebber in New York, doesn't pull any punches. He is convinced that the U.S. defense industry is on a permanent downward slope and that defense industry workers will be hit hard during coming years. "How many defense analysts on Wall Street do we need to say the industry is going down?" he quips.

The defense market, Modzelewski notes, has clearly underperformed the S&P 500. When considering who to pick as winners or losers, he doesn't study the defense budget line by line. "From an investment perspective, that method leads to bad stock calls," he says. "Besides, it drives you crazy. The decisions about which programs get cut are driven by politics and costs and the budget is designed so you can't understand it."

DOD budget cuts will produce tremendous pressure to keep margins up, so defense companies will aggressively cut employment, predicts PaineWebber's Jack Modzelewski

Modzelewski forecasts defense spending will fall around 3% per year over the next five years and employment at defense companies will be cut 6% per year. "There will be tremendous pressure to keep margins up, so defense companies will be aggressive in reducing employment," he says. As companies continue to generate cash in their balance sheets by liquidating inventory, selling buildings, and the like, he expects defense company profits to increase over the next two years, but "this will be the last burst of brightness—like a supernova—before much worse profit performance in 1994 and 1995." If he is right, companies then will compete not just for lost dollars, but for their very existence. □

be going to electronics," agrees Dataquest's Sheppard. "Still, electronics won't be what it used to be." After all, even Blechman's 2% real growth for defense electronics projected to the end of the decade is a far cry from the 13% annual growth of the early to mid-1980s.

The ultimate extension of the DOD's new acquisition policy is a world in which volume weapons production may never occur. Instead, a single prototype would be built for testing. Critics of weapon prototyping, however, are concerned about how the nation can maintain an adequate military/industrial base. "It's baloney because we can't sustain the infrastructure, especially the tens of thousands of second- and third-tier contractors," warns Blechman. "Prototyping is simply being used as a rationale for program cuts."

Regardless of the underlying industrial policy debate, if the DOD's new acquisition strategy sticks, it will mean big changes for defense electronics contractors.

How far and how fast to cut the budget may still be in question, but most agree the decline may be sharper than expected a year ago. While the EIA expects the defense budget to remain at $200 billion in 10 years, others predict that another $40 billion will be cut.

The Bush administration's budget plan submitted in 1991 garnered savings in the defense budget in two ways—cuts in active duty military personnel and the termination of current-generation weapon systems.

Programs cut or postponed include the B-2 Stealth bomber, Advanced Cruise Missiles, the Midgetman missile, the Army's Air-Defense Anti-tank System, Comanche helicopter, Line-of-Sight Antitank system, and the Block III tank (the next-generation M-1 tank). DOD also proposes cutting future procurement of Seawolf submarines and rescinding funding already appropriated for a second and third boat. Canceled or scaled back also were the Advanced Air-To-Air Missiles and the Fixed Distribution System underwater surveillance system.

No matter how you look at those cuts, defense electronics contractors have been hurt. It's time, say many defense experts, for contractors to start looking for government customers outside the DOD. Unfortunately for company planners, that means digging into several hundred more pages of the Budget of the U.S. Government. □

Customers reap rewards of competitive capacitor market

Manufacturers see little market growth, but they strive to maintain—and gain—customers through service

By Barbara Jorgensen

If you're a large user of capacitors, 1992 could be your year. The prospect of continuing flat sales, defense-spending cutbacks, global recession, and vendor reduction has capacitor makers scrambling to differentiate themselves from a small but highly competitive pack. That, says one producer, means "servicing the heck out of the customer." It also means offering the right product mix as demand rises for surface-mount components and higher capacitance in an increasingly smaller footprint.

Vendors agree that customers are calling the shots—and they're all ears. Despite springtime optimism, capacitor sales are expected to be nearly flat this year. In the U.S., 5% growth is predicted at best, bringing the total market up slightly to $2.15 billion, according to New York-based Frost & Sullivan (F&S). Major capacitor end-markets—including automotive, consumer electronics, and computers—are still feeling the effects of the recession, although many capacitor vendors expect them to pick up by the second half of the year. First-quarter sales were good, although one vendor quickly adds that " 'good' is a relative term."

Of the major capacitor types—ceramic, tantalum, aluminum, paper, film, and variable—F&S expects that the latter three will continue to lose market share through 1996. Aluminum is predicted to experience a "modest" five-year growth rate.

Vendors report some bright spots in their telecommunications and surface-mount product lines. "Cellular is driving a lot of our business in the U.S.," says Tom Kuhl, marketing communications manager for Murata Erie North America in Smyrna, Ga.

Surface-mount (SM) capacitors—particularly those devices referred to as multilayer ceramic (MLC) and tantalum chips—continue to be in demand. MLC chips for SM applications account for 80% of all ceramic capacitors and 55% of the total market, says F&S. SM chips accounted for 50% of the solid tantalum market and 26% of the capacitor market.

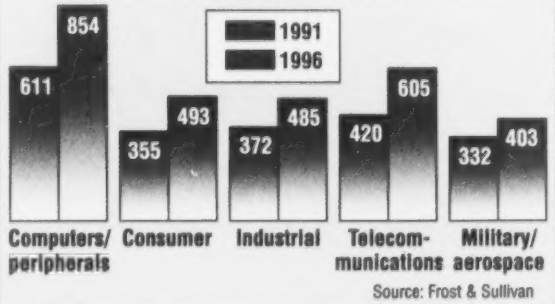
"Everything that's surface-mount is immediately eaten up," notes Allan Cole, vice president for sales at AVX Corp. in Myrtle Beach, S.C. "We're right on the edge of not having enough." One large user of capacitors reports his operations are at about 80% surface-mount. The next drive will be toward smaller SM components, from the 1206 (0.12 in. by 0.06 in., used mostly in the U.S.) down to the 0402 (0.04 in. by 0.02 in., used mostly in Japan). "We have three to four suppliers who adequately serve the market now, but they'll need to press more toward smaller sizes," says the user. The Japanese currently are on the leading edge of smaller surface-mount components: The early push toward miniaturization in Japan's consumer marketplace prompted suppliers such as Murata Erie to emphasize SM chip development 10 to 12 years ago, says Kuhl.

Other suppliers continue to work on improved surface-mount versions, better electrical performance, higher frequencies, low profiles, and higher temperature tolerance. Fused tantalum, for instance, can protect circuit boards from overstressed tantalums that could cause a fire if inserted backwards. There is now no heavy demand for these in the United States, however; they're expensive to make and prices are still too high.

Overcapacity in leaded components– which make up half of some vendors' offerings—continues to depress prices for those products. And the overall sluggish market conditions have capacitor manufacturers

Computer market to drive capacitors in '90s

Capacitor consumption by user groups ($ millions)



Source: Frost & Sullivan

working hard to keep, and maybe gain, customers who increasingly award their business based on intangibles such as quality and service. "We've worked hard to reduce our cycle times," says Greenville, S.C.-based Kemet Electronics' Ed Bost, "and we've gained business because our competitors couldn't deliver [on time], or customers' quality levels weren't being met."

Customers such as Hewlett-Packard Co., IBM, Motorola Inc., and General Motors Corp. long have had tough supplier-qualification programs in place, but vendors report that their second- and third-tier accounts now demand even higher quality and service. "We have to prove we can provide better service than a competitor," says AVX's Cole. That means problem-solving, technical assistance, working with customers on future product designs—as well as competitive pricing. AVX, for example, participated in a design-in with several space station subcontractors whose specs called for absolute reliability and extreme performance, size, and weight restrictions. AVX met the specs, and beat out the competition, by working with the customers on new materials, size, and packaging configurations. "When you are dealing with the design community, a project like this can establish that you'll be the first choice next time they need a specialty product. In a commodity market, those are the kinds of things you have to sell: and comprehensive set of designs, support, and ease of doing business," says Jeff Bartlett, AVX's director of product marketing.

Customers also demand services such as just-in-time (JIT) and dock-to-stock delivery programs, electronic data interchange (EDI), bar-coding capability, and supplier-managed inventory. "Our customers want everything," says Murata Erie's Kuhl. "We're hearing about EDI, which is really turning out to be schedule sharing. Customers send you a six-month window and expect the vendor to manage inventory. If you accomplish that, you're also doing JIT and dock-to-stock—it's putting inventory management back on the supplier. It's a tremendous amount of work, but also a tremendous opportunity—especially when you're talking about customers like Xerox and IBM."

Or like Motorola, which initiated an EDI-type schedule-sharing program with Murata Erie that was based on Motorola's proprietary software. Murata Erie had to learn to implement and use Motorola's system, as well as develop and download its own translation software so the systems could communicate. "There's no standard format we can use with *all* of our customers," says

Top capacitor suppliers

Estimated 1991 U.S. market share*

Ceramics	
AVX/Kyocera	33%
Kemet Electronics	18
Murata Erie	16
Tantalum	
Sprague/Vishay	30%
Kemet Electronics	27
Philips (Mepco/Centralab)	15
Aluminum	
Sprague Technologies	20%
Panasonic Industrial	18
Nichicon	16
Paper and film	
Sprague Technologies	18%
General Electric	17
Westinghouse	13
Variable	
Tusonix	35%
Johanson Manufacturing	20
Sprague-Goodman	14

*General overall categories only

Source: Frost & Sullivan

Tantalums get bigger by getting smaller

Surface-mount (SM) technology isn't driving only the size of components, but also their materials and technology. New York-based market research firm Frost & Sullivan predicts that SM applications will drive tantalum capacitors—the second-largest market after ceramics—from today's market of $485 million to $695 million by 1996. That jump, from 23.2% of the total capacitor market to 24.5%, might not seem like much, but in a mature market facing near-term growth in the single digits, it's worth taking a look at.

Tantalum is well-suited to follow the trend toward smaller, higher-density components because it provides high efficiency in a small size. It also withstands the high temperatures used in printed-circuit-board manufacturing. Some customers use tantalums instead of aluminum and film capacitors because of the inability of the latter two to withstand SM processes. (Some multilayer ceramics, however, are reaching the tolerance levels formerly the domain of tantalums.)

Tantalums haven't taken off in any big way for a couple of reasons—namely, their relatively large size and hefty price. By contrast, "Ceramics are coming in smaller and smaller packages, 0.08 in. by 0.05 in.," says Judy Hausman of NEC, a major manufacturer of tantalum caps. "Tantalums are now in a 0.12 by 0.06 [inch] pack, but we're pushing them to get smaller." Indeed, F&S notes that advances in molded-tantalum chip construction allow manufacturers to comply with size standards so far met only by multilayer ceramic chips.

Tantalums are pricey because they are more specialized and are polarized so they can be inserted only one way. Another reason is that their raw material costs still exceed those of other materials. "At the beginning of the decade, tantalum powder prices doubled," says NEC's Hausman. "But that seems to have come back down and stabilized."

Specialty passives distributor Projections Unlimited Inc.'s president David Herring reports that tantalum and ceramic chips account for half of his entire business. "Everyone will eventually catch up to that," he says. "We try to be on the leading technology edge. But chips are becoming commodity products." □

Kuhl. He adds that another customer, Ford Motor Co., wanted another kind of EDI based on automotive-industry standard bar codes.

Consolidation within the capacitor industry itself has become a competitive equalizer, with a few big global players competing for most of the available businesses. One customer that manufactures globally reports his supplier roster is down from 109 to about six; of that, three suppliers get 97% of his business.

And the few competitors will remain stable. "It's getting to be less of a ball game," observes Judy Hausman, market manager for passive components at NEC Corp. in Mountain View, Calif., a major manufacturer of tantalum capacitors. "There are fewer of us, but it's gotten down to a few big players, like Kyocera/AVX, and Vishay, that won't go out of business."

STILL, NOT ALL global players have been successful at global service. "Our Japanese suppliers were giving us some problems last year in terms of supplying product. And that was a surprise, considering the Japanese market was down," says one capacitor buyer. "They were extending lead times out to 12 or 14 weeks." In some cases this was a result of foreign plants supplying their own domestic customers at the expense of overseas buyers, or inventory being tied up in transit, physically unavailable because it is being delivered by boat. In fact, adds the buyer, some of his company's European facilities were phoning home to get product from the States instead of the Far East because they couldn't get product or their delivery windows weren't being met.

The sluggish market has capacitor manufacturers trying to keep, and maybe gain, customers who award their business based on intangibles

Domestic suppliers, he adds, still stack up fairly well against competitors from the Far East. "Kemet's getting more into the ceramic business, and if they can provide the same quality and service in ceramics that they do in tantalum, they'll put some pressure on the Japanese."

The U.S. is still the single biggest consumer of capacitors, but Electronic Outlook Corp. estimates almost half of the worldwide capacitor market will originate from the Far East by 1995. And this is prompting vendors without a big presence in those markets to redouble their efforts to penetrate them. "Many multinationals have moved their assembly operations offshore, computers and peripherals in particular," says Don Alfson, president, Vishay Electronic Components/Dale, owner of Sprague's tantalum and thick-film capacitor divisions. "We don't penetrate all those markets—specifically Japan—as well as we'd like." To do so, Vishay has set up a new Pacific Rim/Asian operation charged with building new avenues for capacitor sales as well as pursuing manufacturing opportunities

SUCH A GLOBAL presence, Alfson adds, is imperative, particularly because many of those multinationals want to negotiate supplier contracts on a global basis. "They want to talk to one person, and also get one worldwide price," he says.

Even global contracts, though, have to perform on the local level. Codex, a division of Motorola, located in Canton, Mass., is part of one such arrangement. "Lead times and flexibility are critical to us, says Marci Gray, group manager for component engineering, "and we're working toward more aggressive goals than others within Motorola. We convey that to [local] suppliers on our own." Suppliers are given a six-month forecast of Codex's expected needs and are then updated at intervals during the six-month period. Based on those forecasts, suppliers are being asked to whittle lead times down from the current three weeks to two weeks by year-end, one week next year, and *one day* by 1994. That's demanding, even by Motorola's standards.

"The ability to work with us differs from supplier to supplier," Gray adds. "We have some programs in place, while other suppliers say 'We'll try.' It's certainly a differentiator in where we place our business." □

Distributors are seeing more capacitors

The push toward customer service in the worldwide capacitor industry is good news for distributors. In order for capacitor makers to better serve their second- and third-tier accounts—customers that don't order enough volume to deal directly with manufacturers—they're pushing more product through distribution.

About 27% of capacitor sales go through distribution, and suppliers hope to increase that to 34%, reports *Electronics Purchasing* magazine. Manufacturers find distribution sales increase their efficiency, since distributors reach a more varied customer base. "We've definitely seen our [capacitor] volume going up," says David Herring, president of passives distributor Projections Unlimited Inc. "Suppliers find it's the best way to go to market for their smaller accounts—they don't need direct salespeople out there."

The industry-wide drive toward surface-mount is also pushing more sales through distributors. A rash of small contract manufacturers—many of them distributors or affiliated with distributors—offer surface-mount capability to small shops that can't afford to switch over from through-hole assembly. "There are lots of different capacitor values on a board and a lot of different parts [besides capacitors] need to be managed, and that means lots of inventory," says Murata Erie's Tom Kuhl. "Distributors have been hungry for that." □

Hot DSP market tantalizes analog and digital IC makers

Both see gold in growing demand from communications, imaging, and graphics applications. Figuring out which niche to serve is the immediate challenge

By Stephan Ohr

By 1995, every time you pick up a telephone you'll be contributing to the growing market for digital signal processing chips (DSPs). Your modem, fax machine, and car phone also make use of DSP technology, or will soon. This is merely the tip of the iceberg. DSP-based voice recognition systems could replace on-line telephone operators, fax machines will send and receive in color, and video conferencing will take place at your desk.

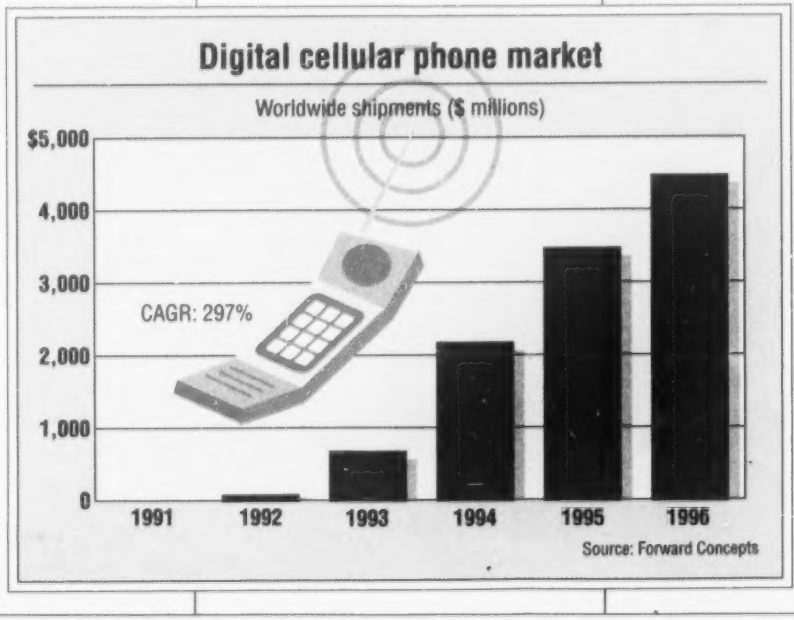
The wealth of new DSP opportunities has already stirred up a hornets' nest of activity, pitting established giants like Texas Instruments and Motorola—who honed their DSP technology through pioneering work for expensive military systems—against lean, fabless upstarts like DSP Group and Star Semiconductor, who hope to capture the emerging market for affordable DSP technology.

DSP chips accounted for some $1.1 billion in sales in 1991, according to market researcher Will Strauss, president of Forward Concepts in Tempe, Az. A 31.2% compounded annual growth rate will grow to $4.2 billion by 1996. More than 40% of this, says Strauss, is communications equipment. However, if you accept that PC-based video conferencing will account for many DSP applications under the 14% "computer" umbrella, or that all-digital telephone answering machines will account for large percentages under the 22.2% "consumer" umbrella, then the telephone-related use of DSPs may be as high as 70%.

Digital signal processing is not the same kind of processing that, say, an Intel 80386/486 applies to Microsoft Windows software or a RISC processor applies to workstation software. Rather, DSP chips manipulate analog signals or waveforms—in most cases by altering frequency content. The analog signal can be a voice or stereo music, a video signal (such as a television image going through a cable), or a radio frequency transmission. By altering its frequency content, the DSP typically filters or compresses the signal, improving its signal-to-noise ratio, eliminating distortion, or, in the case of a video image, making it easier to comprehend. In the case of audio signals, DSP techniques eliminate the hiss, clicks, and pops from old records and tapes.

In the case of high-speed modems, DSP chips shape the serial data stream so that a 9600 bit-per-second or 14.4-kbit/s digital pulse stream can be transmitted and received error-free on a narrower 3-kHz telephone line. With video image processing, DSP will compress a high-frequency video image so that it can be transmitted over lower-frequency telephone lines (albeit 64-kbit/s)—a feature that paves the way for new-generation video phones and conference systems.

Visual image processing, in fact, remains



among the most challenging applications for DSP chips; that is, an application which requires strong math-processing capabilities (accuracy and fast response). This is the high end of the digital signal processing market, which is split between commercial and military applications. The commercial applications include video image compression—a necessary ingredient for desktop video conferencing and video phones. The military imaging applications include visual threat identification and targeting, in which enemy objects are identified in an otherwise ambiguous visual field. DSP imaging techniques, for example, can be used to distinguish tanks or artillery from other objects in a satellite photo.

Apart from obvious differences in cost (commercial parts do not have to go through 883B screenings), commercial and military imaging applications have different processor requirements. Commercial image processing chips—like JPEG encoder/decoders—are part of the market Strauss calls "FASICs," function- and application-specific ICs. These are parts developed and optimized to perform a very specific DSP functions such as image compression. FASICs will account for some of the highest DSP market growth, says Strauss, expanding 33.1% per year from $477 million in 1991 to almost $2 billion in 1996—and that, he admits, may be very conservative. While desktop multimedia and videophone applications accounted for only a small portion of the FASIC market in 1991—3.9% (about $18 million)—this number will grow 99% per year, Strauss predicts.

A variety of high-end DSP suppliers are attacking what may be a lucrative market for JPEG codecs. An international standard of the Joint Photographic Experts Group (JPEG) applies compression to a complex still video image to both reduce the storage space it will require on a hard disk and to reduce the cable bandwidth it requires for transmission. Because of its ability to provide very high quality reproduction and frame-by-frame video editing, JPEG is already being touted as the standard for color electronic publishing (e.g., color Postscript) and color facsimile transmission. Consequently, the field of announced JPEG products is starting to thicken. Early products by C-Cube Microsystems in San Jose and SGS-Thomson Microelectronics in Agrate Brianza, Italy, have all but been eclipsed by more recent entries from LSI Logic in Milpitas, Calif., and others. Zoran Corp. in Santa Clara, Calif., which had produced FASICs (ghost cancellation devices) for digital television, will be out this summer with an integrated JPEG codec small and cheap enough to be used in new-generation Japanese digital recording cameras. The device is a joint development with Japan's Fuji Photo Film Co. As replacements for 35mm single-lens reflex cameras (the high end of the Japanese camera market), Zoran's president, Dr. Levy Gerzberg, sees the total available market (TAM) at close to 4.2 million units—at $25 to $35 per chip.

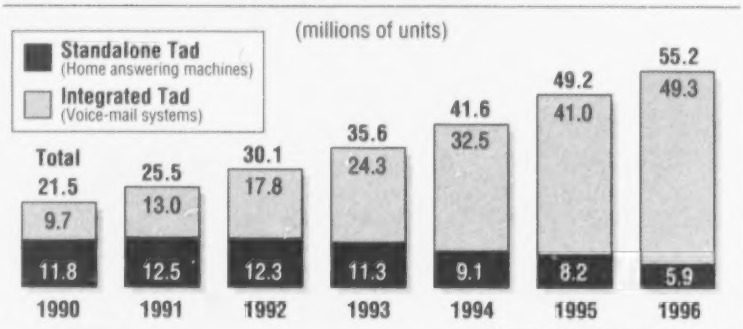
Meanwhile, progress continues on other forms of video image compression. AT&T Microelectronics in Allentown, Pa., announced a three-chip set for multimedia conference applications based on the same technology introduced with the company's VideoPhone 2500. Array Microsystems in Boulder, Colo., previously a supplier of high-end DSP building blocks for military applications, will introduce a similar part to adapt on-the-fly to multiple compression standards. "I may need to revise my multimedia forecast upward," jests Strauss, who currently suggests multimedia DSPs will hit $250 million in 1995.

In contrast to commercial imaging applications, military applications require what Strauss calls "building block" components—numerical processors and sequencers such as ALUs, multipliers, fast fourier transform (FFT) and more discrete cosine transform (DCT) processors, FIR (finite impulse response) filters, and convolvers. He says that, while the military will account for only 10% of the overall DSP market, they will use up to 55% of the DSP building block components.

The building-block market is actually split, says Strauss, between low-end ALUs and data path chips (including address generators) and high-end, more integrated components. Low-end products, like the AMD 2903 family, accounted for $71 million in 1991 sales. Strauss sees this segment declining at a 7% annual rate, while the high-end increases at a 11.2% CAGR. Its 1991 sales were $45 million. For some suppliers, like Texas Instruments in Dallas, the military remains a good business. In 1990, TI had close to 83% of the military DSP market, contends TI's military DSP and ASIC marketing manager, Tom Smith.

Another manufacturer that seems to be doing well in military DSP applications is Intel in Chandler, Az., with its i860 "supercomputer on a chip." "Although it's not designed as a DSP," says Strauss, "it's very

Telephone answering device market rings up increased sales



Source: Ventura Development Corp., EIA and DSP Group

efficient for certain algorithms."

Other DSP equipment manufacturers who focus on the proposed cutbacks in military budgets are beating a hasty retreat. Companies like Semetex in Los Angeles are remarketing industrial visual imaging systems once built for the military object detection techniques. In the case of Semetex, the new system is used for visual inspection of manufactured goods on a factory floor.

Analog Devices Inc. has made strong moves to distinguish itself in commercial realms. At one point in its history, as much as 70% of the company's products—which included high-precision op amps and data converters—went into military channels. Radar tracking systems using ADI 2100 and 21000 family parts are being redesigned for collision avoidance systems; military communications sets become police and fire department radios. But much more needs to done.

To steer its 2101 family DSPs into commercial realms, says ADI product manager Tim Counihan, the company adopted what it calls a "signal computing model." Any design win for DSP must be supported by not just a programmable controller, but also by a front-end linear signal conditioning capability and an easy software programming effort. "Rather than a 'technology in search of a market,' " says Counihan, "you've got to start with an application and make sure that you have a product that does *that* job." A success story for ADI, in this regard, is a PC multimedia chip set that provides MPEG image compression, stereo audio decoding, and also serves as a fax/modem transceiver.

The market that has ADI and everyone else drooling is digital cellular telephone. With digital coding and compression schemes—GSM (Groupe Speciale Mobile) in Europe and TDMA (time division multiple

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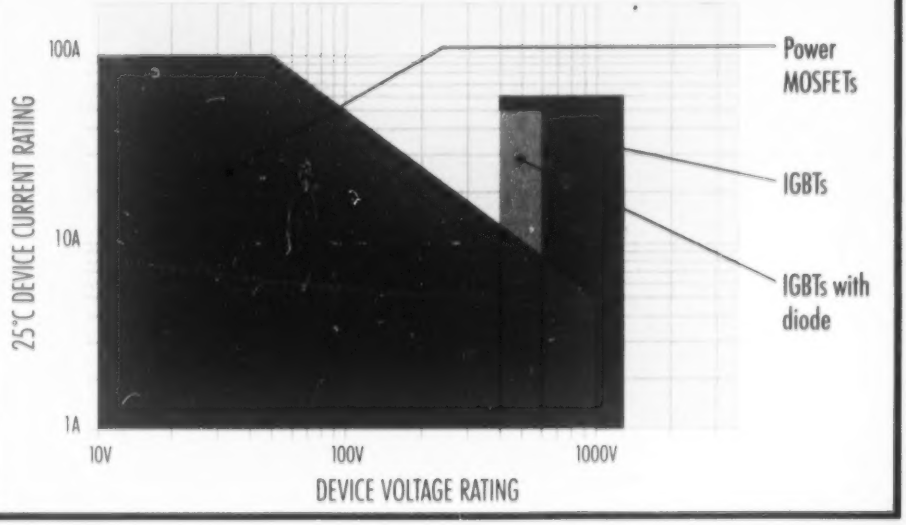

access) in the United States—mobile phone service companies can accommodate more users and provide clearer transmission lines for each one. Mobile phone installations, as a consequence, are expected to increase at a 297% CAGR. There is enormous potential in Eastern Europe, as one example, where there is currently a two-year waiting list for installation of new phone services. As Strauss quips, "They ain't got no wires—people buy cellular telephones for their desk."

Because most cellular telephones are portables fixed at 3-watt outputs and offered to consumers, the market need is for high-transmit power, long battery life, identified as both "talk time" and "standby" life, and the ability to decode transmitter signals quickly.

A DSP user, Teknekron Communications Systems, a $44.8 million network management systems supplier in Berkeley, Calif., is developing voice compression algorithms for TDMA cellular telephone systems, in conjunction with AT&T and Mitsui Comtek Corp., the American arm of Mitsui & Co. in San Jose. Teknekron will utilize the AT&T DSP1616 devices for voice coding, says vice president Amine Haoui, although the company has also built systems in the past with the TI C51/53 (high-performance versions of the TMS320) and the Motorola 56000.

Another communications-related market that will show significant growth for customized DSP processors is consumer electronics. The two major applications are compact audio disk playback systems, and all-digital telephone answering machines. Digital telephone answering machines are based on the DSP's ability to digitize and compress a voice signal. Instead of putting the recorded voice on tape, it can then be recorded in nonvolatile memory. This, in principle, will be cheaper and more reliable than tape recording mechanisms. As replacement units, the TAM for digital telephone answering machines is currently about 25 million units, suggests Asaf Mohr of the DSP Group in San Jose—and is expected to hit over 55 million by 1996 (see Figure 4). Mohr's company develops custom chip sets for this application. Answering machine manufacturers like Phonemate and Sanyo are already customers for the $18 to $25 parts.

A technical advance that will aid the development of DSP FASICs is a DSP algorithm development system announced late last year by a Warren, N.J. start-up, Star Semiconductor. While it is possible to customize TI, Moto, AT&T and ADI processors for particular applications, these devices still carry the chip real estate and performance limitations of general-purpose DSP processors. Fully custom devices, on the other hand, can be expensive and difficult to develop. The Star solution combines a modifiable stream-processing architecture with easy-to-use programming tools. The brainchild of ex-TIer and modem-expert, Jeffrey Robinson, the new company has already reached $1 million in sales and is having difficulty keeping up with demand. The Star System may do for DSP chips what PLDs have done for custom logic parts: add a nice boost to an already growing market. □

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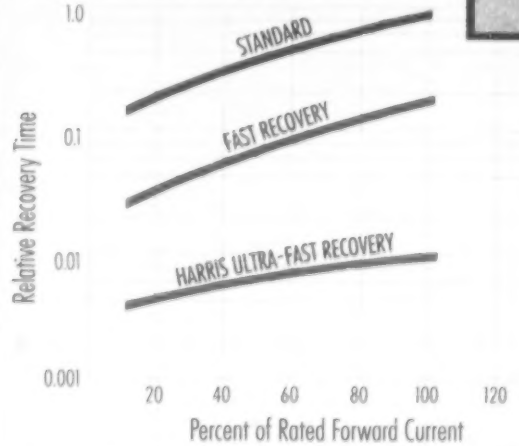

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